DIONEX

INTRODUCING THE DIONEX DX-300 GRADIENT CHROMATOGRAPHY SYSTEMS

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Document No. 034509
Release 01
March 1991

MP MASTER
MA32863

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PRINTING HISTORY

Release 01, March 1991

SAFETY PRACTICES

CAUTIONS and **NOTES** appear throughout this manual to call attention to practices which are potentially hazardous to you, may damage the system, or may prevent optimal performance of the system. These warnings, along with the recommendations below, are intended to help ensure the **safe** operation of your system.

GENERAL PRECAUTIONS

1. Periodically check all liquid lines for leaks. Clean up spills and rinse dried reagents off system components with deionized water.

2. Make sure that gas and liquid lines cannot become kinked, punctured, or otherwise damaged.

3. Store all eluents in appropriately labeled cabinets that are specifically designed for toxic, corrosive, and/or flammable materials.

4. Do not allow liquid wastes to accumulate. Follow a regulated, approved waste disposal program. Never dispose of wastes containing organic solvents through the municipal sewage system. Be sure that all acidic and caustic wastes are neutralized before disposal.

COMPRESSED GAS CYLINDERS

1. Compressed gas cylinders are initially pressurized at 2200-2500 psi. Use a regulator to reduce the delivered air pressure to the required 80-120 psi. Use an additional regulator to reduce the pressure on the eluent reservoirs to a maximum of 7 $\pm$2 psi. This ensures optimal operation of the pump.

2. Fasten all cylinders securely to an immovable structure.

3. Do not store or move a cylinder unless the safety cap is in place.

4. Store or move cylinders in a vertical position only. Do not move the cylinders with regulators attached.

5. Store cylinders in a well-ventilated area, away from heat or ignition sources.

6. Clearly label the cylinder with the contents.

7. Use only approved regulators and tubing connections.

8. Connect cylinders to the system components only with the air tubing provided.

MECHANICAL PRECAUTIONS

The Advanced Gradient Pump (AGP) contains fragile pistons. Before attempting to service the pump, refer to the *Advanced Gradient Pump Operators Manual* (Document No. 034463) for the appropriate precautions to take to avoid damaging or breaking a piston.

ELECTRICAL PRECAUTIONS

1. Panels and enclosures over printed circuit boards or other enclosures cover potentially dangerous voltages. These panels are identified by warning labels. Turn off the system **POWER** and unplug the line cord **before** removing the protective panels. After removing the panels in the pump and detectors, wait 30-60 seconds before touching any printed circuit boards to guarantee the discharge of the capacitors. Similarly, if you are working with the protective cover off for any reason, turn off the **POWER** and allow enough time for the capacitors to discharge before touching any of the boards.

   CAUTION, SHOCK HAZARD: You can be exposed to dangerous voltage even with the POWER turned off. Unplugging the line cord is the best way to protect yourself from shocks.

2. Replace blown fuses with the size and rating stipulated for each component.

3. Replace power cords which have faulty or frayed insulation.

4. Make sure that the selected operating voltage for each component is the same as the actual power line voltage.

SECTION 1
INTRODUCTION

1.1 GENERAL

The Dionex DX-300 Gradient Chromatography Systems are completely inert, metal-free analytical systems for both ion chromatography (IC) and high performance liquid chromatography (HPLC) applications. There are two system configurations:

- The **Standard DX-300** consists of a Standard Advanced Gradient Pump, which provides gradient elution capability; an Advanced High-Pressure Chromatography Module (CHA-3 or CHA-6), a Basic High-Pressure Chromatography Module (CHB-2), or a Liquid Chromatography Module (LCM-3) plumbed with 0.25-mm (0.010-in) ID PEEK tubing; a detector; and enclosures with power strip and drawer slides.
- The **Microbore DX-300** consists of the Microbore Advanced Gradient Pump; a Liquid Chromatography Module (LCM-3) plumbed with 0.125-mm (0.005-in) ID PEEK tubing; a detector; and enclosures with power strip and drawer slides.

Depending on your detection method, your system will also include one or more of the following detectors: the Conductivity Detector Module, Pulsed Amperometric Detector, Pulsed Electrochemical Detector, Variable Wavelength Detector, or Fluorescence Detector.

You can automate operation of the DX-300 with the addition of the Dionex AI-450 Laboratory Automation System or through the Automation Interface in conjunction with a 4270, 4290, or 4400 Computing Integrator fitted with a Timed Functions Option Kit.

An optional Eluent Degas Module (P/N 037124) and a column heater (P/N 035246) are also available.

The modular design of the system components allows the system to be tailored to your specific analytical needs. System components are housed in sturdy, corrosion-resistant enclosures. These enclosures may be stacked to reduce bench space requirements.

1.2 HOW TO USE THIS MANUAL

Comprehensive information about each of the system components is contained in sub-manuals. Each sub-manual lists the specifications of the system component it describes and is divided into sections containing detailed installation, operation, maintenance, troubleshooting, and service instructions.

The sub-manuals for the basic system components are in a single three-ring binder. The sub-manuals for the other system components are included in the component Ship Kits. Add these sub-manuals to the binder to make a complete System Manual. Depending on the specific configuration of your system, the System Manual may include sub-manuals for the Advanced Gradient Pump, an Eluent Degas Module, a Liquid Chromatography Module, a Rheodyne injection valve, and one or more detectors. It may also include an AI-450 Software Manual and an Advanced Computer Interface Manual.

1.3 SYSTEM REQUIREMENTS

- Power Requirements: Single-phase, grounded 100, 120, 220, or 240 volts AC ± 10%; 50/60 Hz
- Power Consumption: 240 W (single-channel) without optional column heater; 540 W with column heater (does not include automation products)
- Pneumatic Pressure Requirements:

  Air-Operated Valves: 90-120 psi (6-8 atm) clean compressed air or nitrogen

  Eluent Reservoirs: 10 psi (0.7 atm) helium, regulated to 7 ±2 psi

  Regenerant Reservoirs: 25 psi (1.7 atm) helium or nitrogen
- Operating Temperature Range: 10° to 40° C (50° to 104° F)
- Operating Humidity Range: 5-95% relative humidity (non-condensing)
- Operating Pressure: 5000 psi (340 atm), maximum
- Dimensions:

  Single-height system enclosure (containing the Advanced Gradient Pump): 20 cm H x 48 cm W x 46 cm D (8 in x 19 in x 185 in)

  Double-height system enclosure (containing the power strip, Chromatography Module, and one or two detectors): 44 cm H x 48 cm W x 46 cm D (17.25 in x 19 in x 18.5 in)

SECTION 2
SYSTEM DESCRIPTION

Each sub-manual contains a detailed description of the corresponding system component. The System **POWER** switch, located on the front of the double-height enclosure at the top left corner, controls the AC power to the system. **POWER** switches for the individual components are located on their rear panels. Switches on the front panels of each component control the operation of that component.

A power strip at the top rear of the double-height enclosure contains the main system line cord connection. Individual line cords from the system components are plugged into the seven switched AC outlets (black) on the power strip. The power strip also includes four unswitched AC outlets (white) which may be used to power accessories.

The pneumatic pressure required to operate the Advanced Gradient Pump and the air-operated valves in the Chromatography Module enters through the rear panel of each module.

Liquid line connections between the system components are made to fittings on the front panels. Eluent from the Advanced Gradient Pump enters the injection valve in the Chromatography Module. The sample loop is filled through the injection port on the front of the Rheodyne injection valve in the Liquid Chromatography Module, or through the sample port on the Advanced High-Pressure Chromatography Module or Basic High-Pressure Chromatography Module. From the injection valve, eluent and sample flow through the column(s) to the detector cell.

Liquid wastes from the pump and the Chromatography Modules exit through the rear panels.

SECTION 3
GENERAL INSTALLATION INSTRUCTIONS

3.1 UNPACKING AND INSPECTION

Inspect the system components for shipping damage as soon as you receive them. Because many carriers limit the claim period to 10 days after the delivery date, report any damage to the incoming carrier immediately.

The DX-300 Ship Kit contains the System Manual binder and System sub-manual. The Ship Kit included with each component contains everything needed to install and maintain that component. The contents of each kit are listed on the packing list included in the package. Please check the contents of each package against the list to make sure that you have received all the components listed. For help in assessing shipping damage, or to report any missing or damaged parts, refer to the list of addresses below and then contact your nearest Dionex Service Office

United States Offices

Dionex Corporation
Corporate Office
Attn. Service Dept.
1228 Titan Way, P.O. Box 3603
Sunnyvale, CA 94088-3603
Phone (408) 737-0700
FAX (408) 736-4476
Telex 348347

Dionex Corporation
Southwestern Regional Office
Attn. Service Dept.
515 North Belt #190
Houston, TX 77060
Phone (713) 847-5652
FAX (713) 847-2203

Dionex Corporation
Central Regional Office
Attn. Service Dept.
1010 Executive Court, Suite 200
Westmont, IL 60559
Phone (708) 789-3660
FAX (708) 789-3702

Dionex Corporation
Eastern Regional Office
Attn. Service Dept.
9 East Stow Road
Marlton, NJ 08053
Phone (609) 596-0600
FAX (609) 596-5358

Dionex Corporation
Western Regional Office
Attn. Service Dept.
470 D Lakeside Drive
Sunnyvale, CA 94086
Phone (408) 737-8522
FAX (408) 733-8748

Dionex Corporation
Southeastern Regional Office
Attn. Service Dept.
1950 Lake Park Drive
Suite 175
Smyrna, GA 30080
Phone (404) 432-8100
FAX (404) 432-8300

International Subsidiaries

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Camberley
Surrey, GU 15 2PL
England
Phone 44(276)691722
FAX 44(276)691837

Dionex S.A.
103, Av. Pierre Grenier
92100 Boulonge
France
Phone 33(1)4621 6666
FAX 33(1)46211369

Dionex GmbH
Richard-Klinger-Strasse 15
D-6270 Idstein
West Germany
Phone 49(6126)6036
FAX 49(6126)57349

Dionex S. R. L.
Vicolo Del Casale
Di San Nicola, 2
00123 Roma
Italy
Phone 39(6)3792979
FAX 39(2)3792984

Dionex B.V.
Takkebijsters, 65
4817 BL Breda
(POB 9338 4801 LH Breda)
The Netherlands
Phone 31(76)714800
FAX 31(76)714940

Dionex Canada Ltd.
2655 No. Sheridan Way
Suite 100
Mississauga, Ontario, L5K 2P8
Canada
Phone (416) 855-2551
FAX (416) 855-2562

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Nippon Dionex K. K.
K K Building
2-3 Iriya 1-Chome
Taito-ku, Tokyo 110
Japan
Phone 81-3-3871-1151
FAX 81-3-3871-1153

Nippon Dionex K. K.
Shin-Osaka, GH Building, Suite 205
9-20, Nishi-Nakajima 6-Chome
Yodogawa-ku, Osaka 532
Japan
Phone 81-6-885-1213
FAX 81-6-885-1215

3.2 FACILITIES REQUIRED

3.2.1 Bench Space

Refer to the dimension specifications in Section 1 and in each component sub-manual to determine the amount of bench space required for your system. Place the system on a sturdy laboratory bench that is at least 60 cm (30 in) deep to provide stability. Additional bench space is required for recorders, integrators, the AI-450 Laboratory Automation System, the Automated Sampler, or other accessories.

3.2.2 Power

The DX-300 System requires a grounded, single-phase power source. The operating voltage and line frequency of 100, 120, 220, or 240 volts AC and 50/60 Hz must be regulated to within ±10%. The operating voltage and line frequency are set at the factory, according to your request, but may be changed during installation. If you are unsure of the line voltage in your lab, contact the appropriate local electrical personnel before installing your system. See the individual component sub-manuals if you need to change the operating voltage.

3.2.3 Pneumatic Pressure

3.2.3.1 Air-Operated Valves

CAUTION: To avoid contamination and possible deterioration of the pneumatic system, use only laboratory compressed air that is filtered, dry, and oil-free.

The injection valve and the column select valve are installed in the Chromatography Module. The two air solenoid valves for valve 5 of the Advanced Gradient Pump (AGP) are used to operate the injection valve, while the two air solenoid valves for valve 6 of the AGP are used to operate the column select valve in the Liquid Chromatography Module and Basic High-Pressure Chromatography Module. Use a regulated source of nitrogen or air pressure to provide the 80-120 psi of pressure required to operate the solenoid valves.

Two additional fluid control valves for each channel are installed in the Advanced High-Pressure Chromatography Module (CHA-6). The CHA-6 has an internal provision for valve control.

3.2.3.2 Eluent and Regenerant Reservoirs

It is essential to degas all eluents and use pressurized eluent reservoirs. This helps prevent bubbles from forming in the pump eluent selector valve and the detector cell. It also ensures optimal operation of the Advanced Gradient Pump.

The pressurized eluent reservoirs require a regulated source of pressure. For optimal operation, use helium, which provides degassing as well as pressure. If helium is unavailable, you may use either argon or nitrogen to pressurize the reservoirs. However, do not use either of these gases for degassing. Vacuum-degas eluents daily when using either of these gases to pressurize the reservoirs.

The pressure applied to the reservoirs must be regulated to 7 ±2 psi. The optional Dionex Eluent Degas Module (P/N 037124) provides continuous on- line degassing and pressurizing of eluents and reservoirs. Use an Eluent Degas Module or install a regulator (P/N 037791) on the supply line to the reservoirs to reduce the pressure. Refer to the eluent reservoir manual for complete installation instructions.

The Membrane Suppressor regenerant requires a pressurized reservoir or a Dionex Auto-Regen Accessory (P/N 039594, 115 VAC version, or P/N 039608, 230 VAC version). The Membrane Reactor reagent also requires a pressurized reservoir. Use a cylinder of nitrogen or other inert gas with a regulator to provide the necessary 25 psi of pressure.

3.2.4 Eluent Filtration

Always filter eluents before operation to remove small particulates that may contaminate the eluent select valve or the pump check valves and cause erratic flow rates or loss of prime. Install a slip-on line filter (P/N 038260) on the end of each eluent tube, inside the reservoir. Make sure that the end of the tube reaches the bottom of the eluent reservoir so as to prevent air from being drawn through the lines.

Next, install an in-line filter holder (P/N 044934) between each eluent reservoir and pump inlet as a "polishing filter".

CAUTION: Filtering eluents is not an optional procedure. Careful filtering of all eluents is one of the single most important requirements for performing successful analyses with any precision gradient pump. Using unfiltered (or inadequately filtered eluents) will often lead to poor performance.

3.2.5 Deionized Water

Use only deionized water when preparing aqueous eluents and reagents or for rinsing procedures. The water must be ASTM filtered Type I water with a background resistivity of at least 16.7 megohms. The use of high quality water reduces background interference and is essential when performing trace-level analyses. To prevent contamination and plugging of the columns and flow system, the water must not contain particles larger than 1-2 microns. Several deionization/filtration systems are available for purchase or lease. Before beginning operation, make sure that an appropriate water supply is available.

3.3 INSTALLATION INSTRUCTIONS

Each sub-manual contains detailed installation instructions for the corresponding component. Read these instructions carefully before beginning installation. Install System 1 and System 2 of a dual-channel system separately.

NOTE: A Dionex Customer Satisfaction Representative will install your DX-300 for you. The installation instructions in this section are for reference.

1. Position all of the system components on the laboratory bench where you will be using them.

2. Connect a source of pneumatic pressure to the Advanced Gradient Pump (AGP), from the AGP to the Chromatography Module, and then to any accessories which include air-operated valves (e.g., the Automated Sampler).

3. Verify that the selected operating voltages for all system components are the same and that they correspond to the line voltage in your laboratory.

4. Connect the line cords to the Fuse/Filter unit on each module. Plug the cords into the black AC outlets on the power strip on the rear of the system enclosure. The black outlets are controlled by the System **POWER** switch on the front of the double-height system enclosure.

5. If you are using an AI-450 Laboratory Automation System to automate your system, connect the relay cables and parallel interface cables between the Advanced Computer Interface (ACI) and the system components.

6. Connect the recorders and/or integrator(s), if used, to the detectors, using the cables provided or any you may have ordered separately.

7. Plug the line cords for any accessories into the four white, unswitched AC outlets on the power strip.

8. Use the tubing provided in the detector Ship Kit to connect the detector cell into the appropriate position in the liquid flow path. If the cell is installed inside the Chromatography Module, extend the cell cables out the rear of the module and connect them to the detector.

9. Set all of the module **POWER** switches to **ON**.

   NOTE: Once you install the modules as part of a system, it is not necessary to turn the modules on and off individually. You can turn the entire system on and off using just the System **POWER** switch.

10. After making sure that the System **POWER** switch on the front of the double-height system enclosure is **OFF**, plug the system line cord into an appropriate power source.

11. Install the optional Eluent Degas Module, if you plan to use it.

12. Connect a pressurized container of degassed deionized water to the Eluent 1 panel fitting of the AGP and prime the pump. Be sure to install a slip-on line filter and an in-line filter holder.

13. Connect the eluent outlet line from the AGP to the injection valve.

14. **Do not** install the separators, suppressors, or Membrane Reactors at this time.

15. Flush the system with deionized water (Section 3.4).

16. Install the column(s) and inspect the system for leaks (Sections 3.5 and 3.6).

3.4 SYSTEM FLUSH

The Advanced Gradient Pump and optional GM-3 Gradient Mixer are filled with alcohol for shipment. To flush out the alcohol, pump deionized water through the system at 9.9 mL/min. for 10 minutes if you have a Standard AGP or at 2.5 mL/min. for 10 minutes if you have a Microbore AGP.

CAUTION: The analytical columns should not be installed during the system flush. Pumping the alcohol through the columns may result in excessive equilibration times following installation.

3.5 SEPARATOR AND SUPPRESSOR INSTALLATION

After flushing the alcohol from the system, install the separator column(s) and suppressor device(s). The columns and suppressors are shipped separately from the DX-300 System. Identify the desired columns and remove the end plugs. Save the plugs for use later when you store the columns.

1. Read the manuals sent with the separators and suppressors for complete installation instructions.

2. Prepare the eluents specified on the test chromatograms. Connect the Eluent Degas Module (if used) to the reservoirs. Connect the reservoirs to the eluent panel fittings on the Advanced Gradient Pump (AGP).

3. Prime the AGP with all of the eluents you plan to use. Prime each eluent separately. Refer to the *Advanced Gradient Pump Operators Manual* (Document No. 034463) for instructions.

4. Prepare the suppressor regenerant (if required) and connect it to the suppressor.

5. Install the columns and suppressors in the Chromatography Module.

6. After installing the columns and suppressors, begin pumping eluent through the system at the flow rate you will be using. Inspect all valve connections for leaks (Section 3.6).

3.6 LEAK INSPECTION

After installing the separator column(s) and suppressor(s), perform the following leak inspection. Inspect one system at a time.

1. Set the injection valve to INJECT and the column select valve to ON. Inspect the connections to the valves for leaks. Tighten leaking ThermoFlare fittings fingertight, then an additional one-eighth turn. If a PEEK double-cone ferrule fitting leaks, tighten the fitting fingertight, then an additional one- quarter turn. **Tighten fittings further only if the leak persists.**

   Use a wrench when connecting or disconnecting a tube fitting from a slider valve. Use a second wrench on the pressure bolt of the column select valve to prevent it from turning. For optimal operation at 4000 psi, the column select valve pressure bolts must be evenly tightened (128 in-oz) against the slider. A loose pressure bolt may cause liquid leaks from the valve, while overtightening a pressure bolt may cause the valve to operate sluggishly or not at all.

   NOTE: The column select valve is tested to operate leak-free at 4000 psi. After testing, the pressure bolts on the valve are loosened slightly for storage and shipment to reduce stress on critical parts. When shipped, these pressure bolts are tightened to provide leak-free operation at pressures up to 2500 psi (90 in-oz torque). If you wish to operate at higher pressures (up to 4000 psi), torque the bolts to 128 in-oz. If the valve will be unused for more than a few days, reduce the torque on the bolts to 90 in-oz to reduce stress on the sealing surfaces.

   The spring force between the rotor and stator of the Rheodyne injection valve is sufficient to hold 5000 psi (34 MPa).

2. Set the injection valve to LOAD and the column select valve to OFF. Inspect the valve connections again for leaks and tighten any leaking fittings.

SECTION 4
OPERATION

4.1 INITIAL OPERATION

After the system is installed, verify that it operates correctly by duplicating the test chromatograms shipped with the columns. This is also an opportunity for you to become familiar with how to operate the system before beginning an analysis of your own.

1. Read the OPERATION section of each component sub-manual for detailed operating instructions.

2. Read the instructions sent with the separators and suppressors for detailed operating instructions.

3. Locate the test chromatogram sent with the separator and review the operating parameters used to analyze the test standard. Select the flow rate indicated on the test chromatogram and allow the system to equilibrate with the eluent to be used in the analysis. Complete equilibration usually requires a minimum of 20 column volumes of eluent.

4. Turn on the recorder. Set the detector output range to a value that keeps the recorder pen on scale. Monitor the baseline; when it stabilizes, select the detector output range indicated on the test chromatogram.

5. Load the sample loop with the standard test solution indicated on the test chromatogram, zero the baseline, and inject the sample.

6. Compare the chromatogram obtained with the test chromatogram.

7. Calculate the efficiency and resolution of the peaks indicated on the test chromatogram (if necessary, refer to Appendix A for the appropriate equations). The calculated values should agree within ±10% of those on the test chromatogram. Slight differences are caused by instrument variations and/or differences in temperature and eluent strength from test conditions.

4.2 ROUTINE OPERATION

Routine operation consists of entering one or more isocratic or gradient programs and then injecting samples using the procedure described above in Section 4.1. The *Advanced Gradient Pump Operators Manual* (Document No. 034463) contains detailed instructions on programming and running a gradient.

4.3 SHORT-TERM SHUTDOWN

Use the following shutdown procedure at the end of daily operation.

1. When using eluents with a moderate to high salt concentration, rinse the fluid system with deionized water for several minutes. This prolongs the life of the sealing components.

2. Turn off the pump and recorders. Set the detector output to its least sensitive range.

3. Leave the system **POWER** on.

4. If you are using an Eluent Degas Module, leave the **SYSTEM ON/OFF** switch in the **ON** position.

4.4 PROLONGED SHUTDOWN

Use the following shutdown procedure if you will not use the system for two weeks or more.

1. Prepare the columns for storage as described in Dionex Technical Note 7.

   CAUTION: Improper storage of columns may result in permanent degradation and loss of performance.

2. Remove the columns from the system and plug the ends.

3. Couple the column lines together and flush the system with either deionized water (if aqueous or water-miscible solvents were used) or a co-solvent such as isopropanol (if non- aqueous or water-immiscible solvents were used) for 10 minutes at 9.9 mL/min. if you have a Standard Advanced Gradient Pump or at 2.5 mL/min. for 10 minutes if you have a Microbore Advanced Gradient Pump.

4. Turn off the main system **POWER** switch and unplug the system line cord.

5. If you are using an Eluent Degas Module, follow the shutdown procedure described in the *Eluent Degas Module Instructions* (Document No. 034042).

SECTION 5
MAINTENANCE AND SERVICE

5.1 ROUTINE MAINTENANCE

Periodically check the interior of the Chromatography Module and the Advanced Gradient Pump for leaks or spills.

- Isolate and repair leaks and clean up any spills.
- Rinse any dried eluent or reagents off the components with deionized water.
- Check all air lines for crimping or discoloration. Move any pinched lines; replace damaged ones.

The Advanced Gradient Pump requires regular lubrication to keep the left piston operating smoothly. Lubricate the piston every three-six months (e.g., if you typically operate 15 hours a day, grease the piston every three months; if you operate eight hours a day, greasing the piston every six months is sufficient). A two-part syringe filled with grease is provided in the AGP Ship Kit for this purpose. Refer to the *Advanced Gradient Pump Operators Manual* (Document No. 034463) for instructions.

Refer to the Maintenance section in each sub-manual for specific maintenance procedures for each component.

5.2 TROUBLESHOOTING GUIDE

The Troubleshooting Guide in each sub-manual is intended to help you isolate and solve minor problems that may arise while operating your system. To use the Troubleshooting Guide, refer to the section that discusses the problem you are having and consider the possible causes. If you are unable to solve the problem by following the advice in the guide, call the nearest Dionex Service Office for assistance (see Section 3.1).

5.3 SERVICE

Each sub-manual includes a Service section with service and repair procedures for mechanical components of the system. All procedures specify the problems they are intended to eliminate.

When ordering replacement parts, please include the model and serial number of the component you are repairing (e.g., the AGP or the LCM-3), along with the part numbers and, where applicable, the revision number of the items you are ordering.

In general, electronic components are not customer-serviceable. Any repairs involving electronic components must be done at a Dionex Regional Service Office, as directed in the Standard Warranty Statement. See Section 3.1 of this manual for the Dionex Office nearest you.

APPENDIX A
GLOSSARY OF CHROMATOGRAPHY TERMS

ANALYTICAL COLUMN — Synonymous with **SEPARATOR COLUMN.**

BAND SPREADING — The broadening of the sample band as it elutes from the column. Band spreading can also occur in the injection valve, the detector cell, and interconnecting tubing.

CALIBRATION CURVE — A graph showing detector response in peak height or area versus concentration.

CELL CONSTANT (k) — A factor determined experimentally by measuring the conductance of a standard solution of known specific conductance (κ). Its value depends upon the surface area of, and distance between, the electrode faces in the conductivity detector cell.

$$k = \kappa/G$$

where: κ = the specific conductance of a standard solution
G = the measured conductivity

CHANNELING — The preferential flow of liquid along more open, less resistant paths through the column packing. This causes **BAND SPREADING.**

COLUMN — A relatively narrow bore tube which holds the chromatographic packing.

COLUMN CAPACITY — The maximum concentration of sample that may be loaded onto a separator before overloading and the resultant loss of retention and non-linear response occur. This concentration is related to the total ionic strength of the sample. When using IC columns, injection of samples with total ionic concentration of greater than about 50 ppm or use of sample loop volumes greater than 1 mL may result in column overloading.

COLUMN EFFICIENCY (N) — A measure of peak dispersion as it moves through a column.

$$N = 5.54\ (t_1/W_{1/2})^2$$

where: t_1 = the peak retention time
$W_{1/2}$ = the peak width at 1/2 height

Column efficiency is proportional to column length: for a given resin and column diameter, increasing the column length increases the column efficiency. Synonymous with **THEORETICAL PLATES.**

COLUMN SELECTIVITY (α)

Describes the relative position of two adjacent peaks. It is a function of the thermodynamics of the exchange process.

$$\alpha = (t_2 - t_0)/(t_1 - t_0) = K_2/K_1$$

where: t_1 and t_2 = retention time of components 1 and 2, respectively
t_0 = retention time of unretained components (void volume)
K_1 and K_2 = distribution coefficients of components 1 and 2, respectively

CONCENTRATOR COLUMN

A short column used to retain ions from a measured volume of relatively clean sample. This concentrates the sample ions and lowers detection limits.

CONDUCTIVITY

A measure of the ease with which electrical current flows through a liquid contained between two oppositely charged electrodes. Conductivity is a characteristic of ions in solution. Units are Siemens (see Appendix A of the *Conductivity Detector-II Operators Manual* (Document No. 034012) for further discussion).

COUNTER ION

Ions carrying a charge opposite that of the resin exchange sites or the sample ions (e.g., Na^+ is the counter ion of a HCO_3^- /CO_3^{2-} anion eluent). These ions preserve electrical neutrality in solution.

% CROSSLINK

Nominal divinylbenzene content in a styrene/divinylbenzene (S-DVB) resin; contributes to resin characteristics such as swelling and mechanical strength.

GUARD COLUMN

Synonymous with **PRE-COLUMN**.

HETP (H)

Height Equivalent to Theoretical Plate. A measure of column efficiency which allows comparison between columns of different lengths.

$$HETP = H = L/N$$

where: L = the column length (mm)
N = the number of theoretical plates

ION EXCHANGE CAPACITY

The number of active ion-exchange sites in a given weight or volume of resin. Most often expressed in meq/g or meq/mL.

ION EXCHANGE RESIN

An insoluble polymer matrix containing charged exchange sites (anionic or cationic). The resins used in IC are formed into small spherical particles (beads).

MHO

Synonymous with **SIEMEN (S)**.

PELLICULAR RESIN

A resin with a solid, non-porous core coated with a thin layer of more porous material. The exchange sites of ion exchange resins are located only on the surface layer of the bead. These resins have a low ion exchange capacity.

PRE-COLUMN

A small column which prevents poisoning of the separator column by absorbing organic contaminants and removing particulates. It is filled with the same packing as the separator column. Synonymous with **GUARD COLUMN.**

REGENERATION

A procedure which reactivates the ion exchange sites in expended suppressor. Packed-bed suppressor columns are regenerated periodically. Membrane suppressors are regenerated continuously, causing no system down time.

RESIN

An insoluble carbon-based polymer used as the structural foundation for chromatographic packings.

RESOLUTION (R)

A measure of the separation between two sample constituents. It is expressed as the ratio of the distance between the two peak maxima to the mean value of the peak width at the baseline.

$$R = 2(t_2 - t_1)/(w_2 + w_1)$$

where t_1 and t_2 = the retention times of components 1 and 2, respectively
w_1 and w_1 = the baseline width of peaks 1 and 2, respectively (measured in the same units as the retention time)

A value of R = 1.5 or greater represents "baseline separation" of the two peaks.

RETENTION TIME

The time from injection to peak maximum; the basis for identification of a species in chromatography on a given system.

SELECTIVITY QUOTIENT (K)

A measure of the affinity of the sample ion for the resin exchange sites. K is directly proportional to the affinity.

SEPARATOR COLUMN

The column used to perform the actual chromatographic separations. Synonymous with **ANALYTICAL COLUMN.**

SIEMEN (S)

Unit measure of conductance; the reciprocal of electrical resistance. Synonymous with **MHO.**

SPECIFIC CONDUCTIVITY (κ)

The conductivity of a solution in a standard cell having electrodes 1 cm^2 in area and exactly 1 cm apart. Every solution has a characteristic specific conductance.

SUPPRESSOR

A device used to minimize eluent conductivity and convert sample species to a common form, thus increasing detection sensitivity. May be either a packed-bed suppressor column or a membrane suppressor.

TEMPERATURE COEFFICIENT

The percent of change in the conductivity of a solution with a 1° C change in temperature. Every solution has a characteristic temperature coefficient which is determined experimentally.

THEORETICAL PLATES (N)

See **COLUMN EFFICIENCY**.

VOID VOLUME (V_0)

The volume occupied by the mobile phase in a packed column (this also includes the volume between the injection valve and the column and between the column and the detector cell). Unretained components are eluted in the void volume.

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